



National Transportation Safety Board

Autorotation Entry and Vehicle Recorders

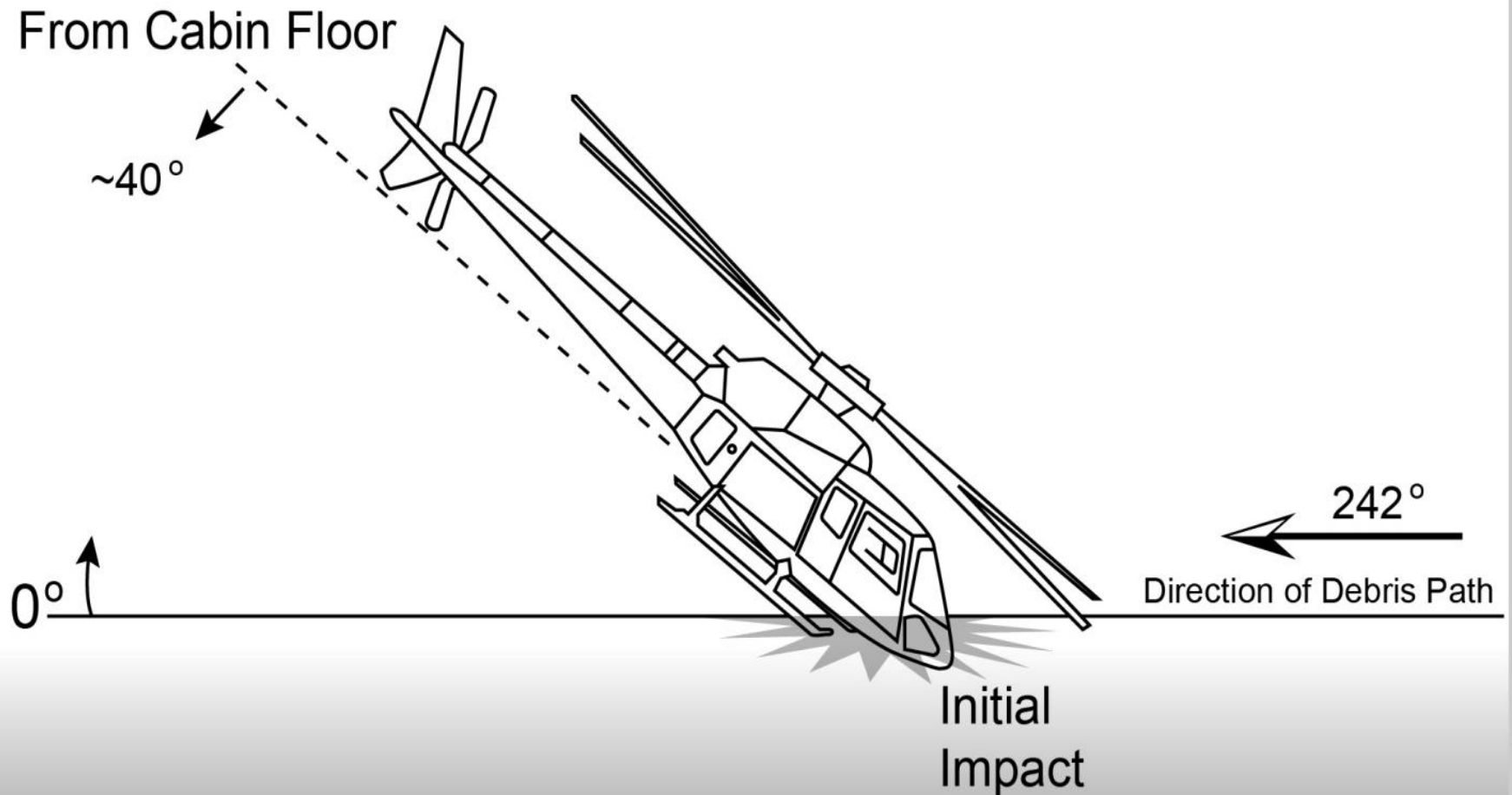




Examination of Wreckage

- Rotor blades exhibited minimal rotational energy at impact
- Impact occurred within 10 seconds of the engine flameout

Estimated Impact Angle



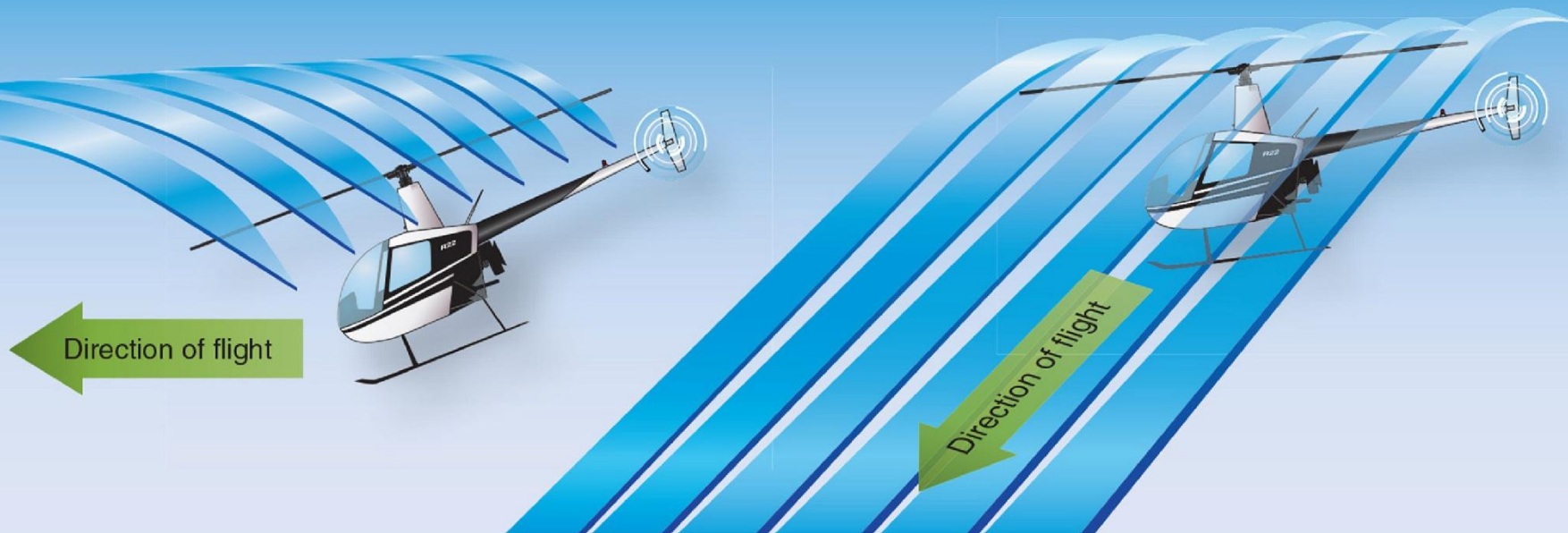
Helicopter Flying Handbook: Pilot Reaction to an Engine Failure

- Immediately lower the collective
 - Lift and drag are reduced
 - Helicopter begins immediate descent
 - Produces upward flow of air through the main rotor system
 - Provides sufficient thrust to maintain rotor rpm throughout the descent

Main Rotor System Airflow

Normal Powered Flight

Autorotation



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Helicopter Flying Handbook

- Minimal information on the entry phase of the autorotation
- Emphasizes lowering the collective
- Does not address simultaneous control inputs
- Does not address use of aft cyclic to prevent rapid loss of rotor rpm

AS350 Autorotation Procedure

Rotorcraft Flight Manual (RFM)

Procedure for all flight conditions

- Set low collective pitch
- Monitor and control rotor rpm
- Establish approximately 65 knot
airspeed

Autorotation Scenarios in Simulator

- Eurocopter AS350 simulator
- Flew various scenarios to determine likely outcomes using different autorotation entry procedures

AS350 Simulator Sessions



Successful Entry and Autorotation

- Flameout
- Initiated at 275 – 300 feet agl
- ~ 115 knots
- Reaction with simultaneous aft cyclic, down collective, and left pedal.
- Time: ~ 27 seconds

Successful Entry and Autorotation



Simulator Video

Unsuccessful Entry

- Flameout
- Initiated at 275 – 300 feet agl
- ~ 115 knots
- Reaction with down collective
- No cyclic
- Time: less than 5 seconds

Unsuccessful Entry



Simulator Video

Lessons Learned: Autorotation Entry

- Simultaneous collective, cyclic, and pedal inputs needed
- Aft cyclic critical to maintaining and regaining rpm at high cruise airspeeds
- Reaction required within about 2 seconds to maintain rotor rpm

Simulator Training

- Realistic autorotation training
- Training in all environmental conditions
- Emergency procedure training
- Scenario-based HEMS training

Lack of Flight Recorder

- Cannot reconstruct the pilot's control inputs during the final moments
- Pitch, bank, and yaw unknown
- Rotor rpm decay rate unknown
- Estimated airspeed and altitude



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